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GREEN MANURING IN CALIFORNIA.

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By *green manuring* is meant the incorporation, through plowing or similar operations, of green organic matter into the soil. The purpose of it is to maintain or increase the organic matter supply of the soil, which, for reasons below given, constitutes one of the most important factors in soil fertility.

Any green crop which yields a large tonnage of material in a short time may be used to add organic matter to the soil. There are some plants, however, which possess not merely the power of yielding large amounts of organic matter, but also the power of gathering from the air the most valuable, commercially, of the elements of plant food—*nitrogen*. These plants—the legumes—other conditions being equal, are therefore to be preferred for green manuring purposes to the non-legumes. They are plants which belong to the well known family of which peas, beans, vetches, alfalfa, the clovers, lupins, and many others are members. More specific information bearing on the choice of green manure crops in California is given below.

Nothing more emphatic can be stated in support of green manuring under the proper conditions than a description of the rôle played by organic matter in soils. Such a description follows:

1. By its binding action on the soil particles and by its sponge-like absorptive power, organic matter makes sandy soils more retentive of moisture. (Improves water holding power.)

2. By its light yet bulky mass it prevents the extremely fine particles of clay soils from running together and becoming cemented. (Improves essential feature of aeration in heavy soils.)

3. Organic matter contains most of the nitrogen found in soils and all plants except the legumes are absolutely dependent on it for their supply of that essential element.

4. Organic matter is the source of energy and the laboratory in which the important beneficial soil bacteria manufacture available plant food and bring about other changes of importance to plants.

5. Through its decomposition by soil micro-organisms, organic matter acts as a source of carbonic acid and other weak acids which help to dissolve and make available the mineral matter necessary to the growth of plants.

Green Manure Crops for California.

Since the addition of nitrogen to California soils is most likely to be the form of fertilization most needed, it is obvious from what has been said above that the leguminous cover crop deserves first consideration where it is possible to obtain even a fair winter growth, for through it

we can obtain not only the organic matter, but the nitrogen which it obtains from the air besides. In the practical experience of fruit growers, and ranchers generally, the common vetch (*Vicia sativa*) and the Canada field pea (*Pisum arvense*) have given the best results as winter cover and green manure crops in California. The bur clover (*Medicago denticulata*) takes the next place to the two mentioned. In general, the vetch does best south of the Tehachapi and in sheltered, and isolated valleys in other places. The Canada field pea is to be preferred in the Sacramento and San Joaquin valleys and adjacent regions. Exceptions will occur to this as to other rules, but the statement will serve as a good guide. Bur clover will do well all over California, but it does not produce as large a tonnage as the vetch nor the field peas. Other crops which may be used when prices of seed allow are fenugreek, tangier peas, and lentils.

If climatic conditions are such as to preclude the possibility of much growth during the winter when ordinary green manure crops are grown, either the vetch or the Canada field peas may be planted together with one of the grains, thus, field peas and oats, or vetch and barley, or bur clover and barley. If no growth at all is made by the legumes then the cereals may be grown alone, provided it is remembered that they do not add nitrogen to the store already in the soil but merely return what they remove. They do, however, add large quantities of organic matter.

Summer Cover Crops.

The cost of water and the ease with which it can be obtained are seldom such in California as to justify the growing of a summer cover crop or green manure crop. Certainly, the experimental trials thus far with summer cover crops have not given results which justify their use. Where, however, water is cheap and can be obtained in large amounts summer cover crops will pay well. This is especially true for soils markedly deficient in humus and nitrogen. Under such circumstances the cow pea, velvet bean, or soy bean will give very good results. These, like the winter growing legumes above described may be combined with one of the cereals. The Whippoorwill variety of the cow pea gives good results in California. About 50 pounds of seed to the acre for irrigated orchards and other irrigated land will give a good stand. *Cow peas are wrongly named and are really beans. They are, therefore, summer growing crops and can not be used as a winter growing green manure crop like the vetch and peas.*

When and How to Plant Green Manure Crops.

Under dry farming conditions the best time to plant a green manure crop is just after the first rains. The seed should be drilled in and about 60 pounds per acre of the vetch seed used or 80 pounds of the field pea seed, because the latter is a larger seed. Of the bur clover seed 20 pounds per acre will do. If vetch is combined with barley or rye about 20 pounds of the cereal with about 45 pounds of the vetch will be a good combination. Similar combinations may be made between field peas and bur clover and the cereals.

As a cover crop and green manure crop in orchards the same legumes above recommended either alone or in combination with the grains may be employed. In orchards which are irrigated the cover crop may be

sown in August or late in July. About 20 pounds per acre, less, of the seed is needed in orchards than on dry farmed land, since there must be considerable waste space between the trees owing to heavy shade in which the green manure crop will not grow.

Plowing Under Green Manure Crops.

Plowing under of green manure crops should be done as late as possible consistent with maintaining good moisture conditions in the soil. This will necessarily vary under different conditions. About the second week in March will be a good time for dry farmed land as a general rule. If the rainfall is very small, plowing under should be accomplished earlier. On irrigated lands, it may often be feasible to let the cover crop grow until about three weeks prior to blossoming time and plowing it under then.

It is important to plow the green material as well as any other form of organic matter deeply into the soil and cover it well. This is particularly true for loose, porous sandy soil. If very tall, the cover crop may first be dragged down with heavy chains or with a roller, then cut up with a disc run both ways and plowed under. Thorough packing and cutting up with a disc after turning under is also important to prevent the soil from drying out.

Precautions to be Observed in Green Manuring.

1. If growing vetch or field peas for the first time, take no chances on possible natural inoculation. (Directions for inexpensive inoculation are fully given in Circular No. 87 on Alfalfa.)

2. When water is scarce do not grow a winter cover crop. It will not only rob trees of water in the case of an orchard, but in dry farmed land will make the soil too dry to grow a profitable crop after it.

3. In addition to danger in cases of lack of water from robbing the following crop of needed moisture, it must be added that when the cover crop is turned under the soil will be too dry to decay it. Therefore, the organic matter will not only give no good effects, but by its bulky nature will leave the soil loose and porous and thus help it to dry and lose moisture all the quicker.

